(~0.75 in) in height, although, again, these dimensions are merely exemplary, and dimensions can vary widely for different embodiments.

[0480] While the principles of the invention have been described herein, it is to be understood by those skilled in the art that this description is made only by way of example and not as a limitation as to the scope of the invention. Other embodiments are contemplated within the scope of the present invention in addition to the exemplary embodiments shown and described herein. Modifications and substitutions by one of ordinary skill in the art are considered to be within the scope of the present invention.

What is claimed is:

1. An apparatus for determining a volume of fluid dispensed comprising:

an acoustic volume sensor comprising:

a structure containing a fixed-volume chamber, a first port, and a measurement chamber, wherein the first port comprises a tube portion and acoustically couples the fixed-volume chamber to the measurement chamber to form an acoustically contiguous region;

a printed circuit board disposed within the structure;

a loudspeaker acoustically coupled to the fixed-volume chamber, wherein the loudspeaker excites the acoustically contiguous region; and

a sensing microphone acoustically coupled to the measurement chamber via a second port, the second port comprising a second tube portion, and the sensing microphone producing a pressure signal;

a dispensing chamber containing a variable fluid volume, an exit channel and a resilient membrane, the dispensing chamber attached to the structure, the resilient membrane defining a boundary between the dispensing chamber and measurement chamber; and

a processor in communication with the loudspeaker and the sensing microphone, the processor determining the volume of fluid dispensed based on a change in the pressure signal.

2. The apparatus for determining the volume of fluid dispensed according to claim **1** wherein the sensing microphone and loudspeaker are located to prevent loudspeaker pressure waves from impacting the sensing microphone without passing through the measurement chamber.

3. The apparatus for determining the volume of fluid dispensed according to claim **1** further comprising a flared aperture adjoined to at least one of the first and second ports, wherein the flared aperture is further attached to the measurement chamber.

4. The apparatus for determining the volume of fluid dispensed according to claim **1** further comprising a dispensing spring, wherein the dispensing spring provides additional resilience to the resilient membrane.

5. The apparatus for determining the volume of fluid dispensed according to claim **1** wherein the printed circuit board partially defines the fixed-volume chamber within the structure.

6. The apparatus for determining the volume of fluid dispensed according to claim **4** wherein the dispensing spring is part of the acoustic volume sensor.

7. The apparatus for determining the volume of fluid dispensed according to claim **1** further comprising a reservoir, valve, and a fluid line wherein the fluid line fluidicly connects the reservoir to the valve and fluidicly connects the valve to the dispensing chamber.

8. An apparatus for determining a volume of fluid dispensed comprising:

an acoustic volume sensor comprising:

a structure containing a fixed-volume chamber, a first port, and a measurement chamber, wherein the first port acoustically couples the fixed-volume chamber to the measurement chamber to form an acoustically contiguous region;

a printed circuit board disposed within the structure, the printed circuit board defining the fixed-volume chamber within the structure;

a loudspeaker acoustically coupled to the fixed-volume chamber, wherein the loudspeaker excites the acoustically contiguous region;

a reference microphone acoustically coupled to the fixed-volume chamber, the reference microphone producing a first signal; and

a sensing microphone acoustically coupled to the measurement chamber via a second port, the sensing microphone producing a second signal;

a dispensing chamber containing a variable fluid volume and a resilient membrane, the dispensing chamber attached to the structure, the resilient membrane defining a boundary between the dispensing chamber and measurement chamber; and

a processor in communication with the loudspeaker, the reference microphone and the sensing microphone, the processor, receiving the first pressure signal and the second signal, correcting the second pressure signal based on the first pressure signal; and determining a of fluid dispensed associated with the second signal.

9. The apparatus for determining the volume of fluid dispensed according to claim **8** wherein the sensing microphone and loudspeaker are configured to prevent loudspeaker pressure waves from impacting the sensing microphone without passing through the measurement chamber.

10. The apparatus for determining the volume of fluid dispensed according to claim **87** further comprising a flared aperture adjoined to least one of the first and second ports, wherein the flared aperture is attached to the measurement chamber.

11. The apparatus for determining the volume of fluid dispensed according to claim **8** further comprising a dispensing spring, wherein the dispensing spring provides additional resilience to the resilient membrane.

12. The apparatus for determining the volume of fluid dispensed according to claim **11** wherein the dispensing spring is part of the acoustic volume sensor.

13. The apparatus for determining the volume of fluid dispensed according to claim **8** further comprising a reservoir, valve, and a fluid line wherein the fluid line fluidicly connects the reservoir to the valve and fluidicly connects the valve to the dispensing chamber.

14. An apparatus for determining a volume of fluid dispensed comprising:

an acoustic volume sensor comprising:

a structure containing a fixed-volume chamber, a first port, and a measurement chamber, wherein the first port comprises a tube portion and acoustically couples the fixed-volume chamber to the measurement chamber to form an acoustically contiguous region;